



(12) **EUROPEAN PATENT APPLICATION**
 published in accordance with Art. 153(4) EPC

(43) Date of publication:
09.04.2014 Bulletin 2014/15

(51) Int Cl.:
A61B 5/15 (2006.01) G01N 1/10 (2006.01)
G01N 35/02 (2006.01)

(21) Application number: **11865765.9**

(86) International application number:
PCT/JP2011/061379

(22) Date of filing: **18.05.2011**

(87) International publication number:
WO 2012/157086 (22.11.2012 Gazette 2012/47)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

- **NAKANO, Yasushi**
Yokohama-shi
Kanagawa 224-0041 (JP)
- **WADA, Yusuke**
Kawasaki-shi
Kanagawa 212-8581 (JP)
- **NAKAMURA, Ichiro**
Kawasaki-shi
Kanagawa 212-8581 (JP)

(71) Applicant: **Techno Medica Co., Ltd.**
Yokohama-shi
Kanagawa 224-0041 (JP)

(74) Representative: **Mannucci, Michele et al**
Ufficio Tecnico Ing.A. Mannucci S.r.l.
Via della Scala 4
50123 Firenze (IT)

- (72) Inventors:
- **MATSUMOTO, Toshikazu**
Yokohama-shi
Kanagawa 224-0041 (JP)
 - **HIRASAWA, Yoshimi**
Yokohama-shi
Kanagawa 224-0041 (JP)

(54) **AUTOMATIC PREPARATION SYSTEM FOR BLOOD COLLECTION TUBE**

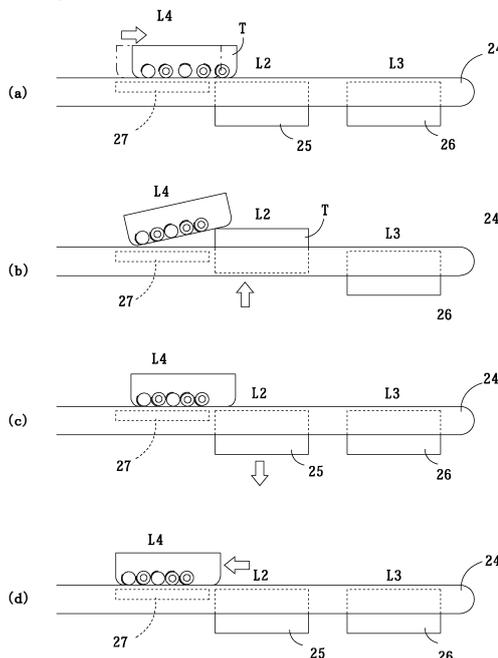
(57) [Object]

An object of the present invention is to provide an automatic blood-sampling tube preparation system which can reduce the reading mistake of the information of the RFID tags.

[Means of Realizing the Object]

An automatic blood-sampling tube preparation system according to the present invention being constituted so as to selectively take out a blood-sampling tube required to an examination of a patient according to a doctor's instruction information from the blood-sampling tube containing section, write the patient examination information on a RFID tag of the taken out tube on the basis of the instruction information, read simultaneously all patient examination information from the all RFID tags contained in the prepared container for every patient, compare the information read from the RFID tags with the instruction information. The automatic blood-sampling tube preparation system takes the prepared tray move so as to change the state of the RFID tags contained in the container and performs the reading process and comparing process.

FIG.7



Description

[Technical field]

[0001] The present invention relates to the improvement of an automatic blood-sampling tube automatic preparation system.

[Background of the Invention]

[0002] If the blood-sampling tube with the collected blood has no information for specifying a patient, it can not understand who has the blood collected. Therefore the name of the patient whose blood is to be collected previously is written on a surface of the blood-sampling tube before collecting blood to identify the blood-sampling tube after blood collecting.

[0003] Recently, in most cases, vacuum blood-sampling tubes are used for collecting blood. Since reaction medicine or a treating solution are previously stored in the vacuum blood-sampling tubes, the use of the vacuum blood-sampling tubes are previously decided in accordance with an examination that should be carried out. Therefore, when collecting blood from a patient, one or more vacuum blood-sampling tubes which can be used for the examination of the patient must be previously selected.

[0004] For this reason, the hospital staff, such as a nurse, selects and takes out beforehand one or more vacuum blood-sampling tubes required to the examination of the patient from many kinds of blood-sampling tubes, before collecting blood. And the hospital staff writes the name of the patient whose blood is to be collected on the surface of the taken-out blood-sampling tubes. The above-mentioned works are dramatically complicated and uses a nerve, so that the works puts a burden on the hospital staff.

[0005] In order to solve above problem, the automatic blood-sampling tube preparation system, which can automate preparation of one or more blood-sampling tubes required to the examination of the patient, has already proposed (refer to Patent documents 1).

[0006] The automatic blood-sampling tube preparation system stores the blood-sampling tubes of a plurality of kinds in separate blood-sampling tube containing cases for each kind. The preparation device automatically selects a blood-sampling tube required to the examination for the patient, takes out the selected blood-sampling tube from the corresponding blood-sampling tube containing case, prints patient information on a label to make an identification label, automatically pastes the identification label on an outer surface of the taken-out blood-sampling tube, and then collects one or more blood-sampling tubes, each having the identification label, for each patient into a tray or a bag.

[0007] Above mentioned automatic blood-sampling tube preparation system may automatically prepare for each patient the blood-sampling tubes required to the

examination of the patient, each blood-sampling tube having the label with the name of patient printed. Therefore, it becomes unnecessary for the hospital staff to make preparations of the blood-sampling tubes before blood collecting.

[0008] However, in the construction of the above-mentioned conventional automatic blood-sampling tube preparation system, it cannot be checked whether the prepared blood-sampling tubes i.e. the blood-sampling tubes contained in the tray for each patient are correct on the basis of the instructions of the doctor.

[0009] Basically, if the automatic blood-sampling tube preparation system is functioning normally, an exact number of required blood-sampling tubes should be stored in the tray. However, for example, when putting the label pasted blood-sampling tube into the tray, the blood-sampling tube may bound on the tray and may fall away the tray. Also while storing the prepared blood-sampling tubes, or while carrying a tray in which the blood-sampling tubes are contained to a blood collecting stand, a blood-sampling tube may fall from the tray.

[0010] A possibility that the above accidents will happen dramatically is low. However, if it takes into consideration that a serious disease may be discovered in the stage of an examination, it needs to avoid arising a blood collecting mistake owing to the mistake of the preparatory step of a blood-sampling tube.

[0011] In order to solve the above-mentioned problem, an automatic blood-sampling preparation system is proposed, the system may being constituted to paste the RFID tag label on the blood-sampling tube, read simultaneously the all information of the blood-sampling tubes contained in the tray and check weather the blood-sampling tubes are correct (patent documents 2).

[Prior art document]

[Patent documents]

[0012]

[Patent documents 11 Japanese Patent No. 2834595B

[Patent documents 2] Japanese Kokai No. JP2004-347376A

[Description of the Invention]

[Problem(s) to be Solved by the Invention]

[0013] According to the above mentioned automatic blood-sampling tube preparation system, it simultaneously read the information from the all RFID tags pasted on the blood-sampling tubes which are contained in the tray and judge whether the kinds of the blood-sampling tubes contained in the tray are correct and/or whether the number of blood-sampling tubes contained in the tray is correct. Therefore, it becomes possible to reduce the

mistake of the preparation step of the blood-sampling tubes.

[0014] However, the blood-sampling tubes stored in the tray are not necessarily located in the same direction with regularity. Depending on the state of the blood-sampling tubes stored in the tray, the preparation system may be unable to simultaneously read the information of a part of RFID tags contained in the tray.

[0015] When the reading mistake of the information of the RFID tags arises, although it is correct in the number and kinds of blood-sampling tubes stored in the tray, the preparation system may be stopped.

[0016] An object of the present invention is to provide an automatic blood-sampling tube preparation system which can solve the above-mentioned conventional problem and reduce the reading mistake of the information of the RFID tags.

[Means for Solving the Problem]

[0017] In order to achieve the above mentioned object, an automatic blood-sampling tube preparation system comprising

at least two blood-sampling tube containing sections each of which is intended to contain blood-sampling tubes of a same type,

a tube transferring means for selectively taking out a blood-sampling tube required to an examination of a patient according to a doctor's instruction information from the related blood-sampling tube containing section and transferring the taken-out blood-sampling tube,

a writing means for writing patient examination information on a RFID tag of the blood-sampling tube based on the instruction information,

a receiving container transferring means for transferring a prepared container in which the written blood-sampling tubes are contained for each patient, a reading means which is arranged in a transferring path of the container transferring means for reading simultaneously all patient examination information from the all blood-sampling tubes contained in the prepared container while the prepared container transferred by the receiving container transferring means, and

a control means for controlling the operations of the said means and comparing the patient examination information read from the RFID tags by the reading means with the instruction information

wherein

the control means is constituted such that if the control means judges that the patient examination information read from the RFID tags do not match the instruction information, the control means makes the prepared container move so as to change the state of the RFID tags contained in the prepared container, after that the control means controls the reading

means to read the patient examination information from the RFID tags contained the prepared container again, and then the control means compares the patient examination information and the instruction information.

[0018] In this specification, "the instruction information from the doctor" includes "the patient examination information". And "the patient examination information" includes at least the sample information such as the sample ID. Also "the patient examination information" may include the patient ID or the examination information.

[0019] Also the prepared container contains the hand pasting label and/or the blood-sampling instruction paper in addition to the blood-sampling tubes. In this case, preferably, the hand pasting label is a label with a RFID tag. And the patient examination information may be written on the RFID tag of the label. When the prepared container contains the blood-sampling tubes as well as the hand pasting RFID tag label the reading means read simultaneously the patient examination information from RFID tags of the blood-sampling tube and the hand pasting label, and the control means compares the patient examination information read from the RFID tags of the blood-sampling tubes and hand pasting label with the instruction information from the doctor. And then if the patient examination information read from the RFID tags do not match the instruction information from the doctor, the control means makes the prepared container move so as to change the state of the blood-sampling tubes and the hand pasting label contained in the prepared container. As a result, the state of the RFID tags of the blood-sampling tube and the hand pasting label are changed.

[0020] Preferably, the prepared container may be moved so as to change the state of the articles contained therein by controlling the operation of the container transferring means. "The articles contained in the prepared container" may be only the blood-sampling tubes. Also "the articles contained in the prepared container" may include the hand pasting label as well as the blood-sampling tubes. By changing the state of the articles contained the prepared container, the state of the RFID tag also are changed.

[0021] Also the automatic blood-sampling tube preparation system according to the present invention may further comprise a label pasting means for pasting the RFID tag label on the blood-sampling tube transferred by said tube transferring means. In this case, said writing means may be constituted to write the patient examination information on the RFID tag of the label. Furthermore, preferably, a printing means for printing the patient examination information on a surface of the RFID tag label may be provided on the automatic blood-sampling tube preparation system.

[0022] If the RFID tag is previously incorporated in the blood-sampling tube, the writing means may be constituted to write the patient examination information on the

RFID tag incorporated in the blood-sampling tube.

[0023] Furthermore, the automatic blood-sampling tube preparation system according to the present invention may be constituted such that said container transferring means comprises a lifting means for lifting up and down the container and the control means controls the lifting means such that a part of the prepared container is lifted by the lifting means so as to change the state of the articles contained in the prepared container.

[0024] Also, the automatic blood-sampling tube preparation system according to the present invention may be constituted such that said container transferring means comprises at least one conveyor on which the container is put for transferring the container and the control means controls the conveyor such that the conveyor rapidly starts to move forward, rapidly starts to move rearward and/or rapidly stops so that the state of the articles contained in the prepared container are changed.

[0025] Also for example the automatic blood-sampling tube preparation system according to the present invention may be constituted such that the control means controls both of the operations of the lifting means and the conveyor so as to change the state of the articles contained in the prepared container.

[Effect of the Invention]

[0026] An automatic blood-sampling tube preparation system according to the present invention comprises

at least two blood-sampling tube containing section each of which is intended to contain blood-sampling tubes of a same type,

a tube transferring means for selectively taking out a blood-sampling tube required to an examination of a patient according to an instruction information from a doctor from the blood-sampling tube containing section and transferring the taken-out blood-sampling tube,

a writing means for writing patient examination information on a RFID tag of the blood-sampling tube based on the instruction information,

a receiving container transferring means for transferring the prepared container in which the written blood-sampling tubes are contained for each patient,

a reading means which is arranged in a transferring path of the container transferring means for reading simultaneously all patient examination information from the all blood-sampling tubes contained in the prepared container while the prepared container transferred by the receiving container transferring means, and

a control means for controlling the operation of the said means and comparing the patient examination information read from the RFID tags by the reading means with the instruction information wherein

the control mean is constituted such that if the control

means judges that the patient examination information read from the RFID tags do not match the instruction information, the control means makes the prepared container move so as to change the state of the RFID tags contained in the prepared container, after that the control means controls the reading means to read the patient examination information from the RFID tags contained the prepared container again, and then the control means compares the patient examination information and the instruction information.

[0027] Therefore, owing to the reading error of the reading device, the system does not stop the automatic blood-sampling preparation device or does not sound an error alarm.

[0028] Since the automatic blood-sampling tube preparation system according to the present invention changes the state of the blood-sampling tubes in the prepared container by moving the container using the container transferring means, it does not need to add the mechanism for exclusive use for only changing the states of the articles in the tray.

[0029] Therefore, in order to perform the retry control, a complicated composition is not needed, and the retry control can apply to the existing automatic blood-sampling tube preparation system easily.

[Brief Description of the Drawings]

[0030]

[Fig. 1] Fig.1 is a schematic front view showing an embodiment of the automatic blood-sampling tube preparation system according to the present invention.

[Fig. 2] Fig.2 is a schematic right side view showing the automatic blood-sampling tube preparation system shown in Fig.1.

[Fig.3] Fig.3 is a schematic top view showing the automatic blood-sampling tube preparation system shown in Fig.1.

[Fig.4] Fig.4 is a schematic cross sectional view along the A-A line in Fig.1.

[Fig.5] Fig.5 is an enlarged view of a label processing means 3.

[Fig.6] Fig.6 shows a label with a RFID tag used in the label processing means 3 and a blood-sampling tube on which the label is pasted.

[Fig.7] Figs.7 (a) to (d) show a conveyor belt 24 and a first lifting means 25 under a retry control.

[Mode for carrying out the invention]

[0031] Referring accompanying drawings, there will be described an embodiment of an automatic blood-sampling tube preparation system according to the present invention hereinafter.

[0032] Fig.1 is a schematic front view showing an embodiment of the automatic blood-sampling tube preparation system according to the present invention. Fig.2 is a schematic right side view showing the automatic blood-sampling tube preparation system shown in Fig.1. Fig.3 is a schematic top view showing the automatic blood-sampling tube preparation system shown in Fig.1. Fig.4 is a schematic cross sectional view along the A-A line in Fig.1.

[0033] The automatic blood-sampling tube preparation system comprises an automatic blood-sampling tube preparation device 1 and a blood-sampling tube recovery device 20.

[0034] The automatic blood-sampling tube preparation device 1 is provided with four blood-sampling tube containing sections 2a - 2d for containing the blood-sampling tubes a1 - a4 respectively, a tube transferring means 4 for selectively taking out one or more blood-sampling tubes required to one of more examinations from the corresponding blood-sampling tube containing section and transferring the taken-out blood-sampling tubes to a label processing means 3 which prints any information on a label, writes any information on a RFID tag provided on the label, and pastes said label with RFID tag up on the blood-sampling tube, and a discharge conveyor 5 for discharging the label pasted blood-sampling tube. Said tube transferring means 4 comprises four pushing means 6a-6d for pushing out the blood-sampling tube from each of the blood-sampling tube containing sections 2a-2d. The tube transferring means 4 also comprises four first delivery means 9a-9d each of which receives the blood-sampling tube taken out by the each pushing means 6a-6d and passes the received blood-sampling tube to a rack 8 provided on a transferring conveyor 7. Said transferring conveyor 7 extends to the label processing means 3 arranged in an upper portion of the automatic blood-sampling tube preparation device 1 along the four blood-sampling tube containing sections 2a-2d. The tube transferring means 4 further comprises a second delivery means 10 which receives the blood-sampling tube from the rack 8 of the transferring conveyor 7 and passes the received blood-sampling tube to a label pasting position X of the label processing means 3.

[0035] As shown in Fig. 5, the label processing means 3 comprises a printer 11 for printing information with respect to one or more examinations of a patient, i.e. patient examination information, on a label provided with a RFID tag, i.e. a RFID tag label, a platen roller 12, a peeling member 13, a RFID tag label holding band feed roller 14, a label holding band recovery roller 15, a pasting roller 16, a pressing means 17, and a support roller 18. The label processing means 3 also comprises a writing device 19 for writing the patient examination information on the RFID tag of the label. Said pasting roller 16, the support roller 18 and the pressing means 17 are arranged to define the label pasting position X together.

[0036] Said label printer 11 prints the patient examination information on the surface of the RFID tag label with

the form of a bar code and characters based on the doctor's instruction information about the examination of the patient corresponding to the blood-sampling tube transferred to the label pasting position X.

[0037] Also the writing device 19 writes the patient examination information on the RFID tag of the label based on the instruction information of the doctor corresponding to the blood-sampling tube transferred to the label pasting position X.

[0038] Here, the patient examination information is information for managing the blood-sampling tube and the sample therein before and after blood collecting, and, specifically, includes sample information including a sample ID and so on. Also, the patient examination information may include a patient ID, a patient name, etc. if needed.

[0039] The printed and written RFID tag label is sent towards the blood-sampling tube positioned in the label pasting position X and said pasting roller 16, so that the label is pasted on the blood-sampling tube by the pasting roller 16, the support roller 18 and the pressing means 17 in the label pasting position X.

[0040] Fig.6 shows the RFID tag label used in the label processing means 3 and the blood-sampling tube on which the label is pasted. As shown in the Fig.6, the RFID tag label comprises a printing surface, an antenna and a chip. The antenna and the chip are disposed under the printing surface. The RFID tag label is constituted so that the patient examination information may be printed on the printing surface thereof and may be written in the chip thereof. It is not required that items of the patient examination information printed on the printing surface of the label and items of the patient examination information written in the chip of a RFID tag are completely the same. Specifically, since the information printed on the printing surface of the label is used also for visual confirmation, it is desirable to include the item of the patient name in the printed information. However, since the information written in the chip of the RFID tag is not use for visual confirmation, it is not necessary to include the item of the patient name in the written information.

[0041] The label pasted blood-sampling tube is dropped on the discharging conveyor 5 which is disposed under the label processing means 3, and is discharged from the automatic blood-sampling tube preparation device 1 by this conveyor 5.

[0042] A blood-sampling tube recovery device 20 is arranged beside the automatic blood-sampling tube preparation device 1. The blood-sampling tube recovery device 20 is constituted so that one or more label pasted blood-sampling tubes which are discharged from the automatic blood-sampling tube preparation device 1 may be stored for every patient in a tray T as a receiving container according to the present invention.

[0043] Specifically, the blood-sampling tube recovery device 20 has an empty tray containing section 21 in which one or more empty trays are accumulated and stored.

[0044] Also the blood-sampling tube recovery device 20 comprises a prepared tray containing section 22 in which one or more prepared trays which contain one or more label pasted blood-sampling tubes for one patient respectively are accumulated and stored.

[0045] Further the blood-sampling tube recovery device 20 comprises a receiving container transferring means 23.

[0046] The receiving container transferring means 23 is provided with two conveyor belts 24 which are separated mutually and are arranged in parallel each other.

[0047] Said two conveyor belts 24 are arranged so that both belts 24 may pass through a blood-sampling tube receiving position L1, an empty tray receiving position L2, and a prepared tray discharging position L3.

[0048] At the blood-sampling tube receiving position L1, the tray laid on the conveyor belts 24 receives the label pasted blood-sampling tube discharged by the discharge conveyor 5 from the automatic blood-sampling tube preparation device 1.

[0049] At the empty tray receiving position L2, the conveyor belts 24 receive the empty tray supplied from the empty tray containing section 21.

[0050] At the prepared tray discharge position L3, the conveyor belts 24 send the prepared tray to the prepared tray containing section 22.

[0051] In this embodiment, the blood-sampling tube receiving position L1, the empty tray receiving position L2 and the prepared tray discharge position L3 are sequentially arranged on a straight line.

[0052] A first lifting means 25 is arranged at the empty tray receiving position L2 between the two conveyor belts 24. The first lifting means 25 takes out an empty tray from the empty tray containing section 21 and takes it on the conveyor belts 24. A second lifting means 26 is arranged at the prepared tray discharge position L3 between two conveyor belts 24. The second lifting means 26 lifts up the prepared tray in which the one or more label pasted blood-sampling tubes are contained from the conveyor belts 24 and pushes it into the prepared tray containing section 22.

[0053] Furthermore in this embodiment, a reading device 27 for reading the patient examination information from the RFID tags is arranged in a reading position L4 between two conveyor belts 24. The reading position L4 is positioned between the blood-sampling tube receiving position L1 and the empty tray receiving position L2.

[0054] In Figs.2 and 3, a numeral number 30 indicates an instruction paper issuing device. The instruction paper issuing device 30 makes a blood-sampling instruction paper based on the instruction information of the doctor and discharges it into the tray positioned in the blood-sampling tube receiving position L1.

[0055] Also the instruction paper issuing device 30 makes one or more hand pasting labels for manual pasting if needed based on the instruction information of the doctor. One or more hand pasting labels are issued when one or more blood sampling tubes of the kind which are

not contained in the automatic blood sampling tube preparation device are used for the examination of the patient. Said hand pasting labels are also the RFID tag labels. Based on the instruction information of the doctor, the patient examination information is printed on the label and is written on the RFID tag.

[0056] Said automatic blood-sampling tube preparation device 1, the blood-sampling tube recovery device 20 and the instruction paper issuing device 30 are controlled by a control device 31.

[0057] The control device 31 controls the blood-sampling tube transferring means 4 such that the blood-sampling tube required for the examination of the patient is taken out the corresponding blood-sampling tube containing section 2a-2d and the taken-out blood-sampling tube is transferred to the label processing means 3 on the basis of the instruction information of the doctor. Also the control device 31 controls the label processing means 3 such that the patient examination information corresponding to the transferred blood-sampling tube is printed on the label and is written on the RFID tag of the label and the printed and written label is pasted on the transferred blood-sampling tube. Furthermore the control device 31 controls the discharging conveyor 5 to discharge the label pasted blood-sampling tube from the automatic blood-sampling tube preparation device 1.

[0058] Also the control device 31 controls the first lifting means 25 to take out an empty tray from the empty tray containing section 21, and to put it on the conveyor belts 24. The control device 31 also controls the conveyor belts 24 such that the empty tray taken out from the empty tray containing section 21 is transferred to the blood-sampling tube receiving position L1.

[0059] The control device 31 controls the conveyor belts 24 to stop the tray at the blood-sampling tube receiving position L1 until the label pasted blood-sampling tubes, the instruction paper and the hand pasting labels if needed which are required to the examination of the one patient are completely contained in the tray.

[0060] All of these articles are contained in the tray, and then the control device 31 controls the conveyor belts 24 to transfer the prepared tray to the reading position L4.

[0061] When the prepared tray arrives at the reading position L4, the reading device 27 reads simultaneously all of the patient examination information in the RFID tags of the all articles (namely, the blood-sampling tubes and the hand pasting labels if needed) in the prepared tray.

[0062] The control device 31 compares the all patient examination information read from the RFID tags with the instruction information of the doctor.

[0063] When the patient examination information read from the RFID tags coincide with the patient examination information included in the instruction information of the doctor, the control device 31 controls the conveyor belts 24 to transfer the prepared tray to the prepared tray discharge position L3. And then the control device 31 controls the second lifting means 26 to lift up the prepared tray positioned at the position L3 to the prepared tray

containing section 22.

[0064] The control device 31 performs a retry control, when the patient examination information read from the RFID tags do not coincide with the patient examination information included in the instruction information of the doctor.

[0065] Hereinafter, the retry control will be explained.

[0066] Figs. 7(a) to (d) show the functions of the conveyor belts 24 and the first lifting means 25 during the retry control.

[0067] As shown in Fig. 7 (a), in case that the patient examination information read from the RFID tags do not coincide with the instruction information of the doctor, the control device 31 controls the conveyor belts 24 such that the prepared tray is transferred to a position where a part of the prepared tray overlaps above the first lifting means 25.

[0068] Subsequently, the control device 31 controls the first lifting means 25 to rise so as to fully incline the prepared tray (Fig. 7 (b)). After that the control device 31 lowers the first lifting means 25 to the lowest position thereof so that the prepared tray puts on the conveyor belts 24 (Fig. 7 (c)).

[0069] Then, the control device 31 makes the conveyor belts 24 transfer the prepared tray to the reading position L4 again, and makes the reading device 27 simultaneously read the patient examination information from the RFID tags of the blood-sampling tubes in the prepared tray (Fig. 7 (d)).

[0070] Since the reading device 27 is arranged near the first lifting means 25 in this embodiment, while moving the prepared tray up and down by the first lifting means 25, it is possible to simultaneous reading of the patient examination information from the RFID tags of the articles (the blood-sampling tubes and the hand pasting label if needed) stored in the tray by the reading device 27. As above mentioned, in case that the reading device 27 may read the patient examination information from the RFID tags of the articles stored in the tray while moving the prepared tray so as to move the articles in the tray, it is also possible to skip the process of returning the prepared tray to the read position L4 again.

[0071] As shown in Figs. 7(b) and 7(c), since the prepared tray is inclined once by the first lifting means 25, the blood-sampling tubes move within the tray so as to change the state of the RFID tags provided in the labels pasted on the blood-sampling tubes within the prepared tray. Thereby, the state of the RFID tags stored in the prepared tray are changed by moving the prepared tray and then the reading device 27 may simultaneously read the patient examination information of the RFID tags again. As a result, the reading error which may arise according to the state of the articles in the tray may be reduced.

[0072] The number of times of performing this retry control may be decided arbitrarily.

[0073] In case that even if the retry control is performed predetermined number of times, the patient examination

information read from the RFID tags do not coincide with the instruction information of the doctor, the control means 31 stops the retry control and performs an error process.

5 **[0074]** As long as the error process may inform a user that the patient examination information read from the RFID tags do not coincide with the instruction information of the doctor, arbitrary processes may be used for the error process.

10 **[0075]** For example the error process may be a process which suspends the automatic blood-sampling tube preparation system, and emits an alarm and/or a warning lamp, etc.

15 **[0076]** According to the above mentioned automatic blood-sampling tube preparation system, when the patient examination information read from the RFID tags do not coincide with the instruction information of the doctor, the retry control is performed. In the retry control, the state of articles such as the blood-sampling tubes in the tray are changed, and then the control means has a function that makes the reading device read the patient examination information from the RFID tags again. Therefore, there may be reduced the reading error which may arise according to the state of articles, such as the blood-sampling tubes in the tray. Therefore, when exact numbers of articles are stored in the tray, control device 31 does not judge that the patient examination information read from the RFID tags do not coincide with the instruction information of the doctor owing to the reading error by the reading device. Therefore, the control means 31 does not stop the operation of the automatic blood-sampling tube preparation system owing to the reading error by the reading device. Therefore, according to the automatic blood-sampling tube preparation system concerning this embodiment, it becomes possible to perform exact and efficient processing.

30 **[0077]** Since the above-mentioned automatic blood-sampling tube preparation system changes the state of the blood-sampling tubes in the prepared tray by controlling the first lifting means that takes out the empty tray and the conveyor belts which transport the prepared tray, it does not need to add the mechanism for exclusive use only for the retry control. Therefore, in order to perform the retry control, a complicated composition is not needed, and the retry control can apply to the existing automatic blood-sampling tube preparation system easily.

40 **[0078]** Furthermore, since the reading device 27, the first lifting means 25 and the second lifting means 26 are arranged between the two conveyor belts 24 for transferring the tray in the automatic blood-sampling tube preparation system, the whole system is compact.

50 **[0079]** Also, in the above-mentioned automatic blood-sampling tube preparation system, the blood-sampling tube receiving position L1, the read position L4, the empty tray receiving position L2 and the prepared tray discharge position L3 are arranged in a straight line in order. Therefore, in the read position L4 between the blood-sampling tube receiving position L1 and the prepared tray dis-

charge position L3, the reading process by the reading device 27 and the retry control process can be performed while transferring the prepared tray to the prepared tray discharge position L3 from the blood-sampling tube receiving position L1.

[0080] In the above-mentioned embodiment, the automatic blood-sampling tube preparation system is constituted so that the prepared tray may be inclined by the first lifting means 25. However, without limiting this arrangement to this embodiment, the automatic blood-sampling tube preparation system may be constituted so that the prepared tray may be inclined using the second lifting means 26.

[0081] In the above-mentioned embodiment, the states of the articles such as the blood-sampling tube or the like in the tray are changed by inclining the prepared tray using the first lifting means 25 so that the state of the RFID tags is changed. However, without limiting this composition to this embodiment, the automatic blood-sampling preparation system may be constituted such that the control device has a function that makes the conveyor belts 24 rapidly move forward so as to change the states of the articles contained in the tray on the conveyor belts. Also the mechanism for exclusive using to only change the states of the articles in the tray may be provided on the automatic blood-sampling preparation system.

[0082] When performing the retry control two or more times, the container transferring means may be controlled to combine different operations such that the prepared tray is inclined by means of the first lifting means in the 1st retry control and then the prepared tray is moved by making the conveyor belts 24 rapidly move forward and rapidly stop in the 2nd retry control.

[0083] Furthermore, in the above-mentioned embodiment, the control device is constituted such that the retry control may be performed if the patient examination information read from the RFID tags do not coincide with the patient examination information included in the instruction information of the doctor. The comparison of the patient examination information read from the RFID tags and the doctor's instruction information may also include the comparison of the number of the articles with RFID tag contained in the prepared tray and the number of the blood-sampling tubes included in the instruction information. Therefore the control device may be constituted to recognize the number of the articles (the blood-sampling tubes and the hand pasting labels if needed) contained in the prepared tray on the basis of the patient examination information read from the RFID tags by the reading device and to perform the retry control if the recognized number of the articles do not coincide with the number of the blood-sampling tubes included in the instruction information.

[0084] Furthermore the control device may be constituted such that when the patient examination information read from the RFID tags and the patient examination information included in the instruction information of the

doctor are compared one by one so that the patient examination information included in the instruction information remains, the control device judges they do not coincide, and performs the retry control.

5 **[0085]** In the above mentioned embodiment, the automatic blood-sampling tube preparation system comprises the automatic blood-sampling tube preparation device and the blood-sampling tube recovery device. Said preparation device includes a plurality of the blood-sampling tube containing sections put on multi stage, in which the blood-sampling tubes are laid down horizontally. And said recovery device collects the label pasted blood-sampling tubes discharged from the preparation device in the tray.

10 **[0086]** However the construction of the automatic blood-sampling tube preparation system according to the present invention is not limited to this embodiment. For example, the preparation system according to the present invention may comprise one device which takes out one or more required blood-sampling tubes from the blood-sampling tube containing sections, makes the identification RFID tag labels, pastes the each label on the each blood-sampling tube, and collects the label pasted tubes into the suitable container for each patient.

15 **[0087]** Also the automatic blood-sampling tube preparation system according to the present invention may be constituted as follows. For example, the blood-sampling tube containing section may comprise a rack in which one or more blood-sampling tubes are held in a standing condition. And the transferring means may comprise a robot arm which operates with the X-Y axis established on said rack. In this case, the control device may be constituted to make the prepared rack transferring conveyor rapidly move forward and rapidly stop so as to change the states of the blood-sampling tube contained in the rack.

20 **[0088]** Furthermore, in the above embodiment, the label processing means is constituted to print the patient examination information corresponding to the blood-sampling tube transferred by the blood-sampling tube transferring means on the label and write the information on the RFID tag. However, the construction of the label processing means is not limited to this embodiment. For example the label processing means may be constituted only to write the patient examination information on the RFID tag without performing printing on the label.

25 **[0089]** Also, in the above mentioned embodiment, the label processing means is constituted to write the patient examination information on the RFID tags of the label. However, the construction of the label processing means is not limited to this embodiment. For example, the processing means may be constituted to directly write the patient examination information on the RFID tag previously incorporated in the blood-sampling tube.

30
35
40
45
50
55 [Description of the reference numeral]

[0090]

a1-a4	Blood-sampling tube	
T	Receiving container / Tray	
X	Label pasting position	
L1	Blood-sampling tube receiving position	
L2	Empty tray receiving position	5
L3	Prepared tray discharge position	
L4	Reading position	
1	Automatic blood-sampling tube preparation device	
2a-2d	Blood-sampling tube containing section	10
3	Label processing means	
4	Tube transferring means	
5	Discharging conveyor	
6a-6d	Pushing means	
7	Transferring conveyor	15
8	Rack	
9a-9d	First delivery means	
10	Second delivery means	
11	Printer	
12	Platen roller	20
13	Peeling member	
14	RFID tag label holding band feed roller	
15	Label holding band recovery roller	
16	Pasting roller	
17	Pressing means	25
18	Support roller	
19	Writing device	
20	Blood-sampling tube recovery device	
21	Empty tray containing section	
22	Prepared tray containing section	30
23	Receiving container transferring means	
24	Conveyor belt	
25	First lifting means	
26	Second lifting means	
27	Reading device	35
30	Instruction paper issuing device	
31	Control device	

Claims

1. An automatic blood-sampling tube preparation system comprising
 at least two blood-sampling tube containing sections (2a-2d), each section being intended to contain blood-sampling tubes of a same type,
 a tube transferring means (4) for selectively taking out a blood-sampling tube required to an examination of a patient according to an instruction information indicated by a doctor from the related blood-sampling tube containing section (2a-2d) and transferring the taken-out blood-sampling tube,
 a writing means (19) for writing patient examination information on a RFID tag of the blood-sampling tube based on the instruction information,
 a receiving container transferring means (23) for transferring the prepared container in which the written blood-sampling tubes are contained for each pa-

tient,
 a reading means (27) which is arranged in a transferring path of the container transferring means (23) for reading simultaneously all patient examination information from the all blood-sampling tubes contained in the prepared container while the prepared container transferred by the receiving container transferring means (23), and
 a control means (31) for controlling the operation of the said respective means and comparing the patient examination information read from the RFID tags by the reading means with the instruction information
characterized in that
 the control means (31) is constituted such that if the control means (31) judges that the patient examination information read from the RFID tags do not match the instruction information, the control means (31) makes the prepared container move so as to change the state of the RFID tags contained in the prepared container, after that the control means (31) controls the reading means (27) to read the patient examination information from the RFID tags contained the prepared container again, and then the control means (31) compares the patient examination information and the instruction information.

2. The automatic blood-sampling tube preparation system according to claim 1,
characterized in that
 the automatic blood-sampling tube preparation system further comprises
 a hand pasting label issuing means for making the hand pasting label with RFID tag to which the patient examination information is written and discharging the hand pasting RFID tag label to the prepared container,
 said prepared container contains the information written blood-sampling tube as well as the hand pasting label with RFID tag to which the patient examination information has been written,
 said reading means reads simultaneously all patient examination information from the blood-sampling tube and the hand pasting RFID tag label, and
 said control means (31) compares the patient examination information read from the blood-sampling tube and the hand pasting RFID tag label with the instruction information.
3. The automatic blood-sampling tube preparation system according to the claims 1 or 2,
characterized in that
 said control means (31) controls the receiving container transferring means (23) such that the prepared container is moved so as to change the state of the articles contained in the prepared container.
4. The automatic blood-sampling tube preparation system according to any one of claims 1 to 3,

characterized in that

the automatic blood-sampling tube preparation system further comprises

a label pasting means for pasting the RFID tag label on the blood-sampling tube transferred by said tube transferring means (4) and

said writing means (19) is constituted to write the patient examination information on the RFID tag of the label.

5

10

5. The automatic blood-sampling tube preparation system according to claim 4,

characterized in that

the automatic blood-sampling tube preparation system further comprises a printing means for printing the patient examination information on a surface of the RFID tag label.

15

6. The automatic blood-sampling tube preparation system according to any one of claims 1 to 3,

characterized in that

said writing means (19) is constituted to write the patient examination information on the RFID tag provided in the blood-sampling tube.

20

25

7. The automatic blood-sampling tube preparation system according to any one of claims 1 to 6,

characterized in that

said container transferring means (4) comprises a lifting means (5) for lifting up and down the container and

the control means (31) controls the lifting means (25) such that a part of the prepared container is lifted by the lifting means (25) so as to change the state of the articles contained in the prepared container.

30

35

8. The automatic blood-sampling tube preparation system according to any one of claims 1 to 7,

characterized in that

said container transferring means (23) comprises at least one conveyor (24) on which the container is put for transferring the container and

the control means (31) controls the conveyor (24) such that the conveyor rapidly starts to move forward, rapidly starts to move rearward and/or rapidly stops so as to change the state of the articles contained in the prepared container.

40

45

50

55

FIG.1

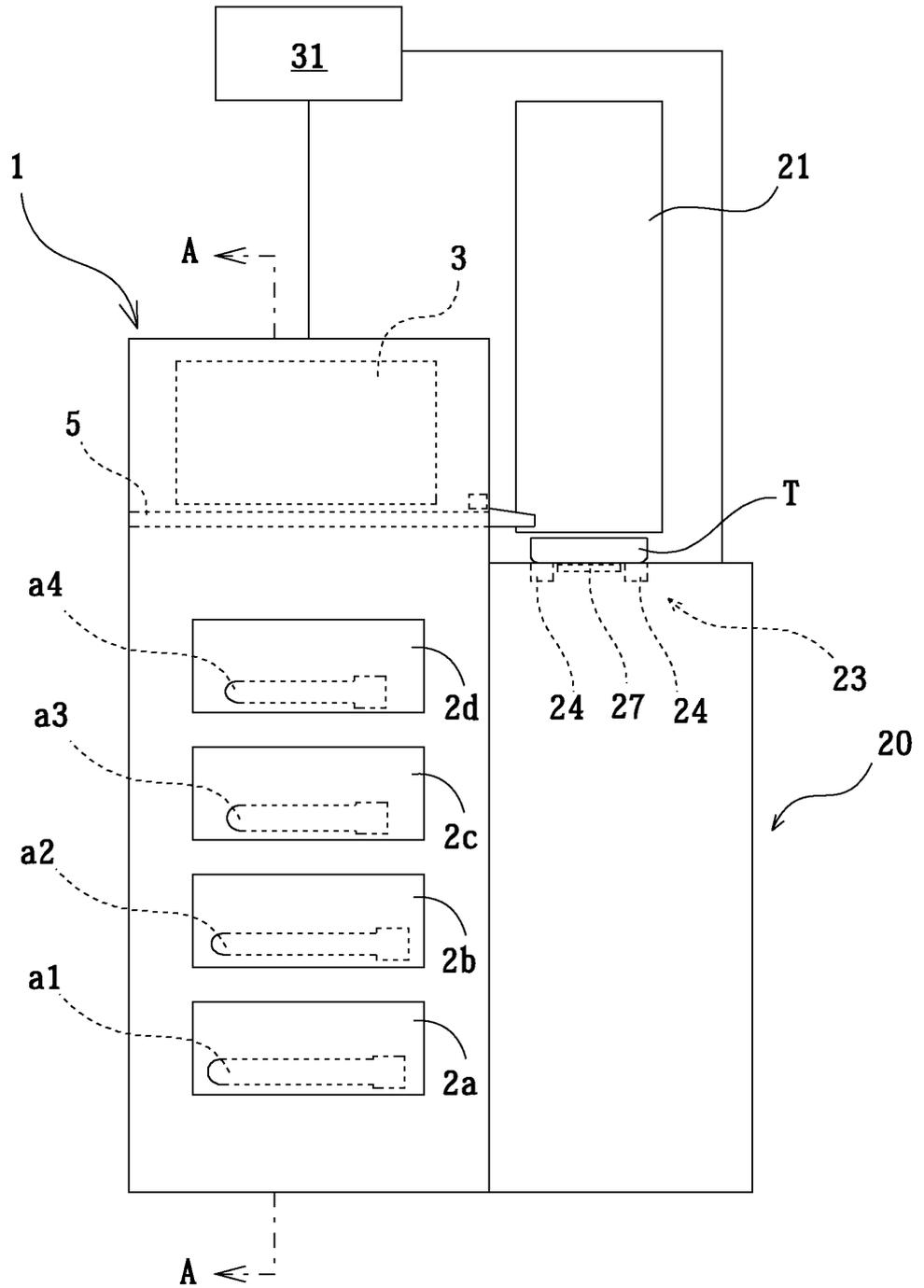


FIG.2

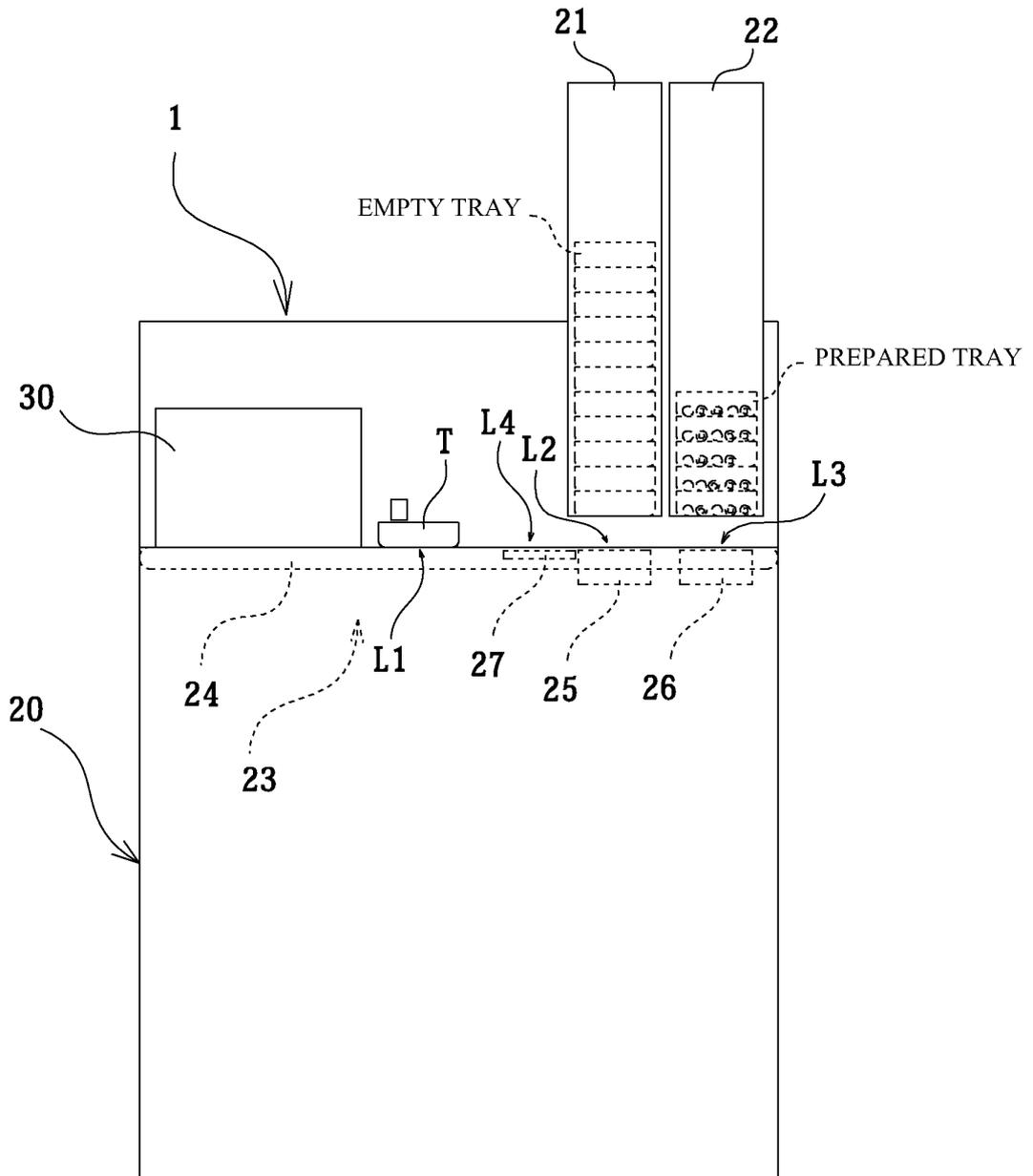


FIG.3

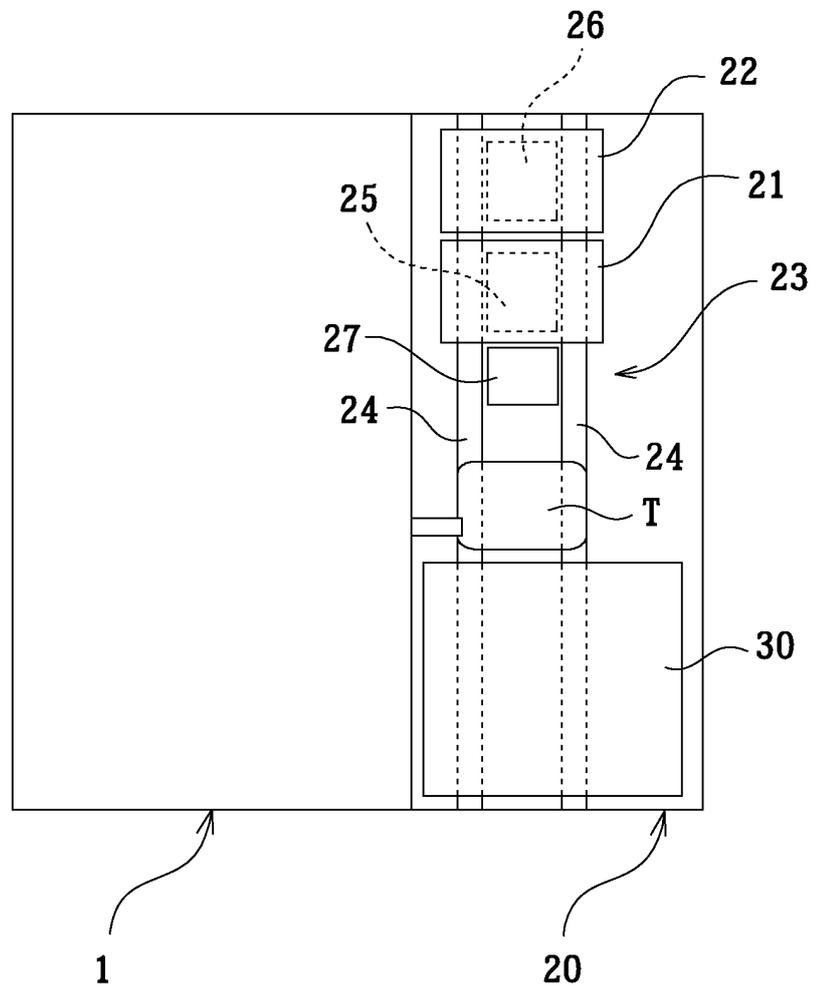


FIG.4

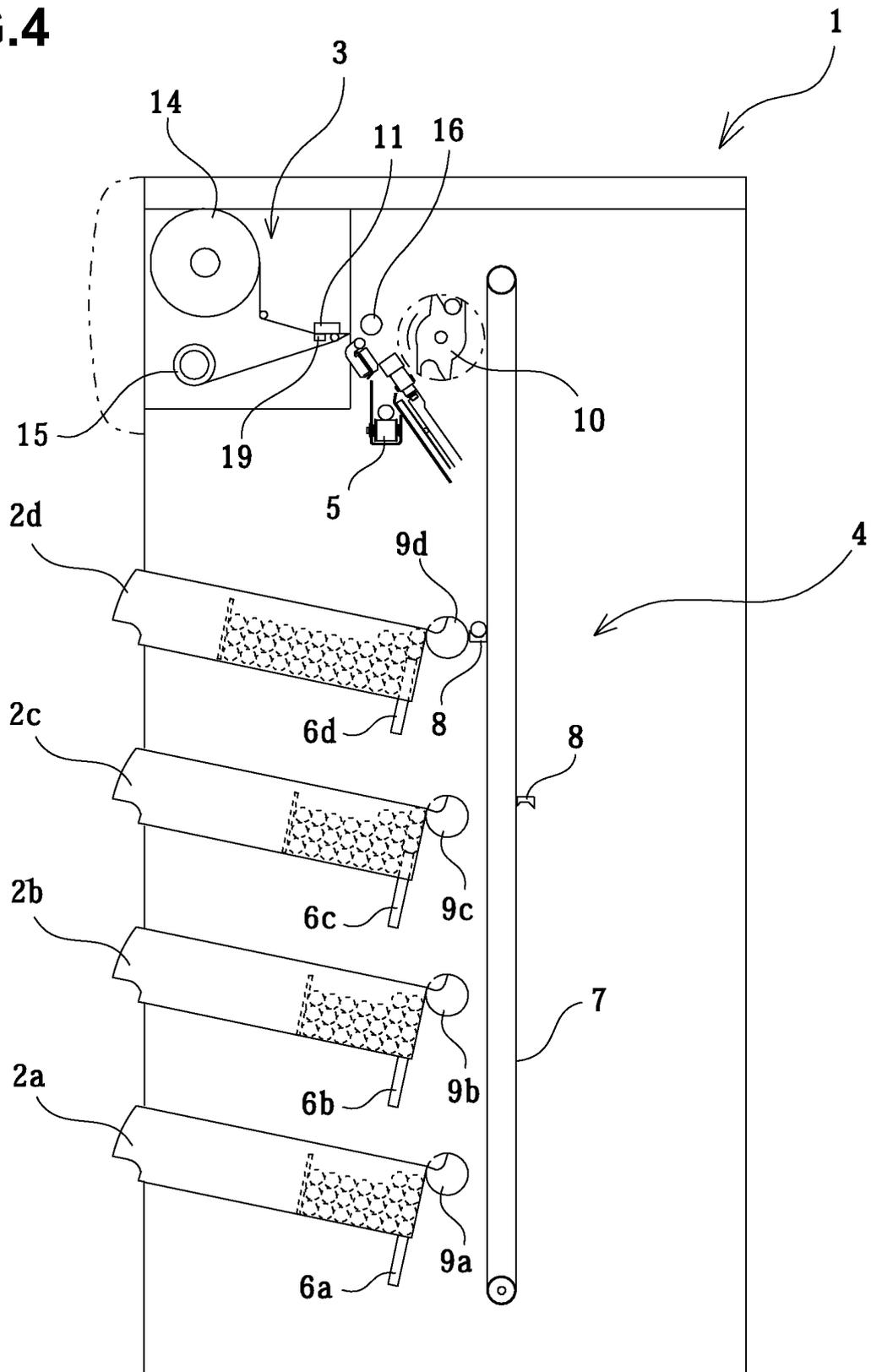


FIG.5

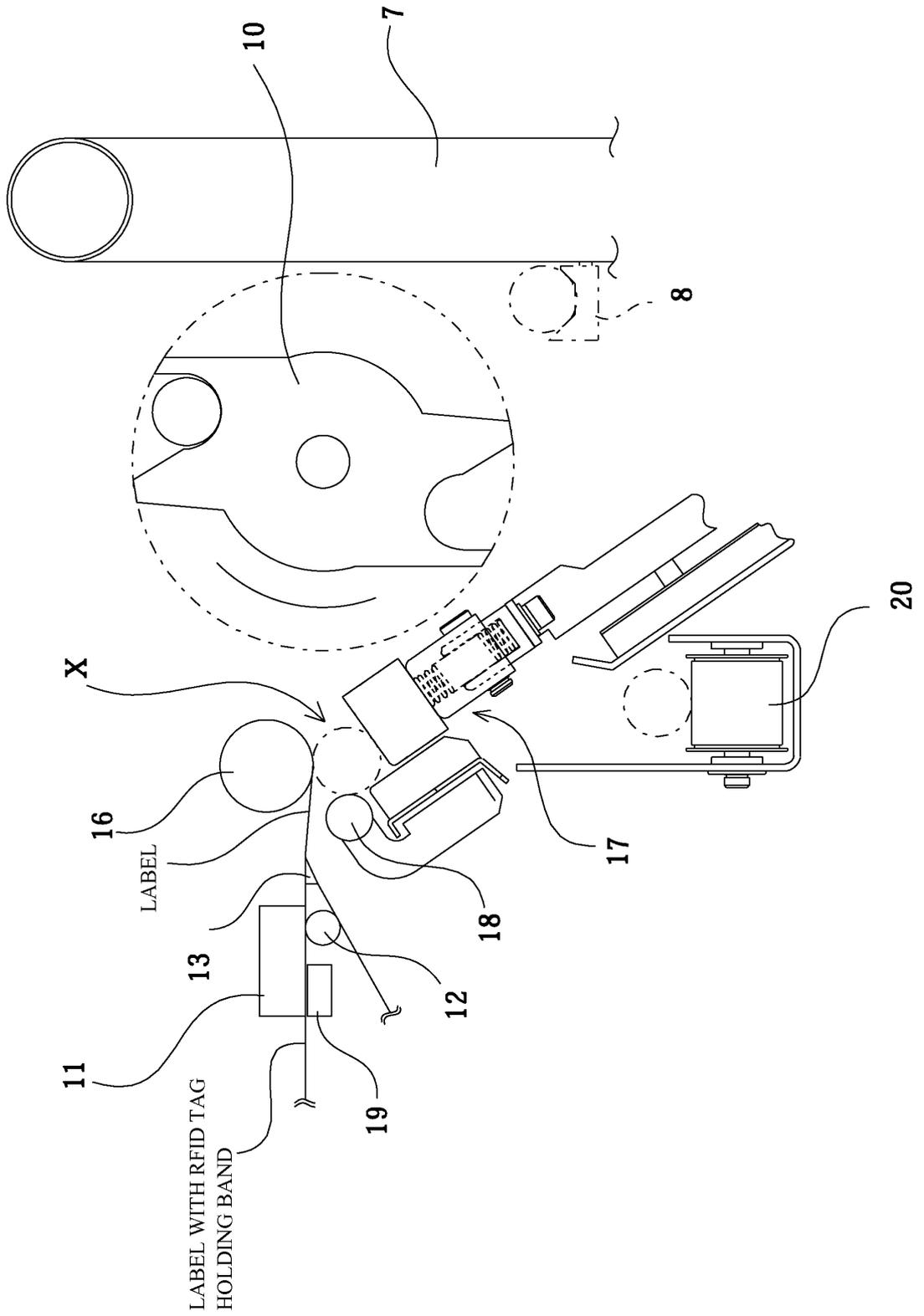


FIG.6

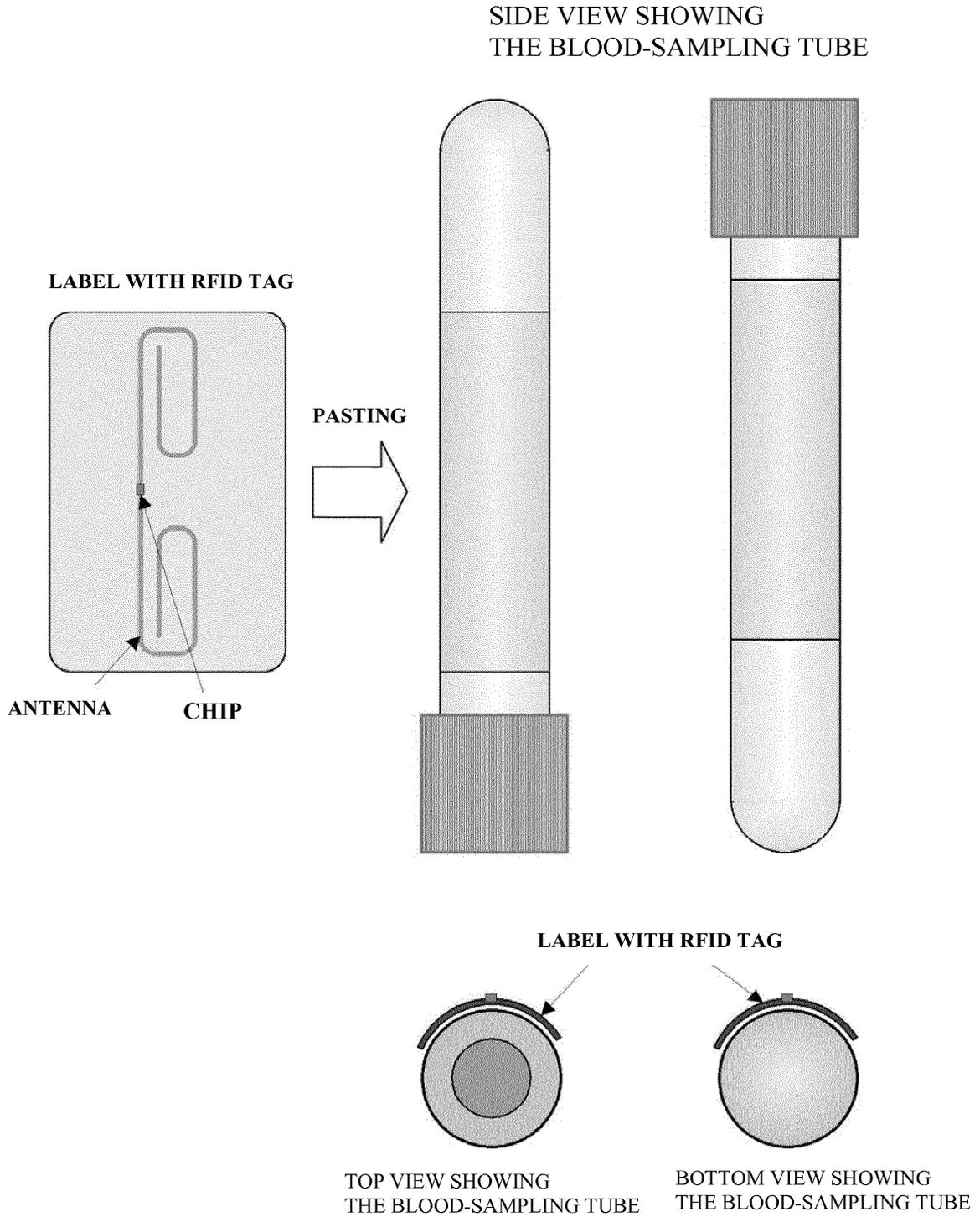
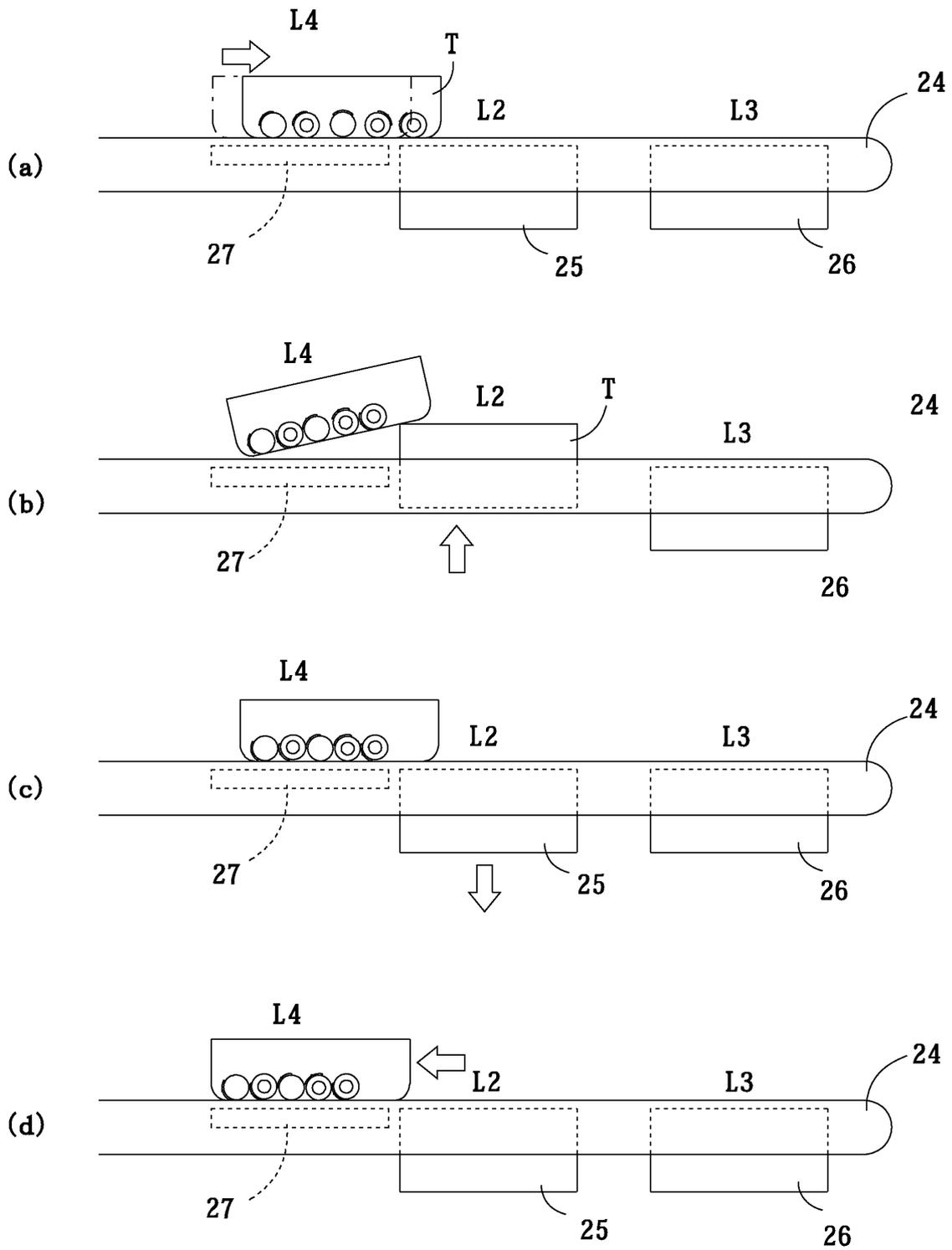


FIG.7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/061379

A. CLASSIFICATION OF SUBJECT MATTER A61B5/15(2006.01)i, G01N1/10(2006.01)i, G01N35/02(2006.01)i		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) A61B5/15, G01N1/10, G01N35/02		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011 Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-347376 A (Techno Medica Co., Ltd.), 09 December 2004 (09.12.2004), entire text; all drawings (Family: none)	1-8
A	JP 2008-220995 A (ASTEC corp.), 25 September 2008 (25.09.2008), entire text; all drawings (Family: none)	1-8
A	JP 2005-121558 A (Techno Medica Co., Ltd.), 12 May 2005 (12.05.2005), entire text; all drawings (Family: none)	1-8
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 16 August, 2011 (16.08.11)		Date of mailing of the international search report 30 August, 2011 (30.08.11)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2834595 B [0012]
- JP 2004347376 A [0012]